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GLACIERS OF PRINCE WILLIAM SOUND AND THE SOUTHERN PART OF THE KENAI PENINSULA, ALASKA

III.—GLACIERS OF THE WEST COAST OF PRINCE WILLIAM SOUND*

BY

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The western shore of Prince William Sound south of Passage Canal is away from the usual routes of travel, and has been little visited even by prospectors. As a result the details of the shore line have not been well shown on recent maps, most of which have evidently relied on the information furnished by the older Russian charts. The glaciers also have not been studied until very recently, and they have been shown in a generalized manner or omitted entirely from the maps. In 1887, Captain S. Applegate explored and first mapped the upper part of Port Nellie Juan†, and in 1905, 1908 and 1909 the writers made a reconnaissance of the west shore of Prince William Sound for the United States Geological Survey. The results of the mapping of 1887, 1905, 1908 and 1909 have been in-

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Earlier articles in this series appeared in the *Bulletin*, vol. 42, 1910, pp. 721-738, and vol. 43, 1911, pp. 321-338. A general map of Prince William Sound, showing the location of the various fiords and bays noted below, accompanies the first of these articles, and another map, showing in more detail the northwestern part of the Sound, accompanies the second article.

† Quoted by George Davidson. The glaciers of Alaska that are shown on Russian charts or mentioned in older narratives. *Trans. and Proc.* Geogr. Soc. of the Pacific, series 2, vol. 3, 1904, pp. 1-98.

corporated in two recently published small scale maps.* The glaciers of this area have not, as far as our knowledge goes, been figured or described before, but some of them have been mentioned briefly.

PASSAGE CANAL

There are no glaciers which reach tide water on Passage Canal, although several approach the canal from the north, west, and south-

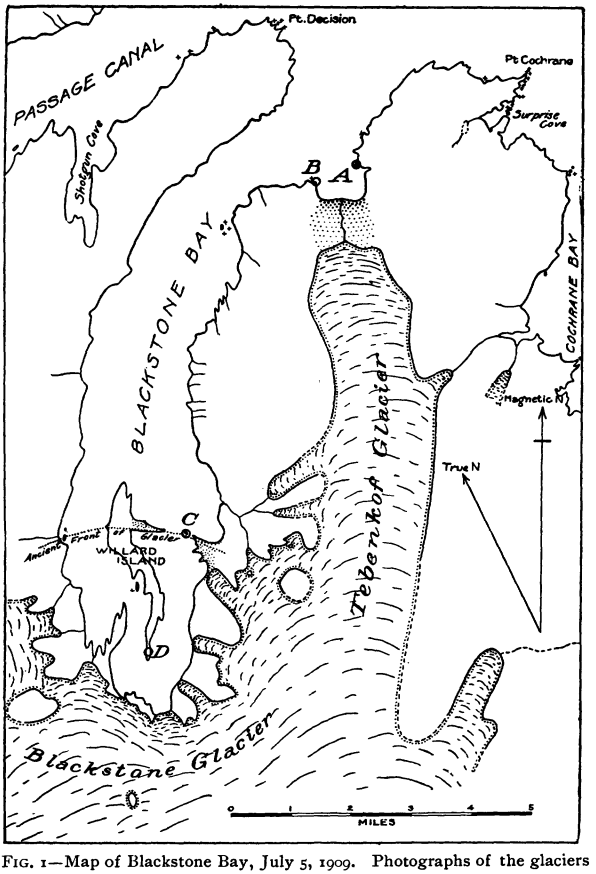

FIG. 1—Map of Blackstone Bay, July 5, 1909. Photographs of the glaciers were taken from points marked A, B, C, and D.

west. The Seth and Billings glaciers descend southward from the same general ice field which feeds the Harriman Glacier and end within about a mile of the north shore of Passage Canal. Northwest of the upper part of the Canal are at least three smaller glaciers

* U. S. Coast and Geodetic Survey, Chart No. 8550, 1909. U. S. Geological Survey, *Bull.* 442. pl. 2, 1910.

draining into this body of water.* The most important ice stream near the Canal is the Portage Glacier, described below.

Portage Glacier

A hasty visit was made by our party to the head of Passage Canal (Portage Bay) on July 3, 1909. The eastern terminus of Portage Glacier was too far distant from the shore and too much hidden by a low bare rocky point in the gravel-filled valley to permit of any careful observations. It is probable that no large part of the glacier debouches on the east side of the divide between Passage

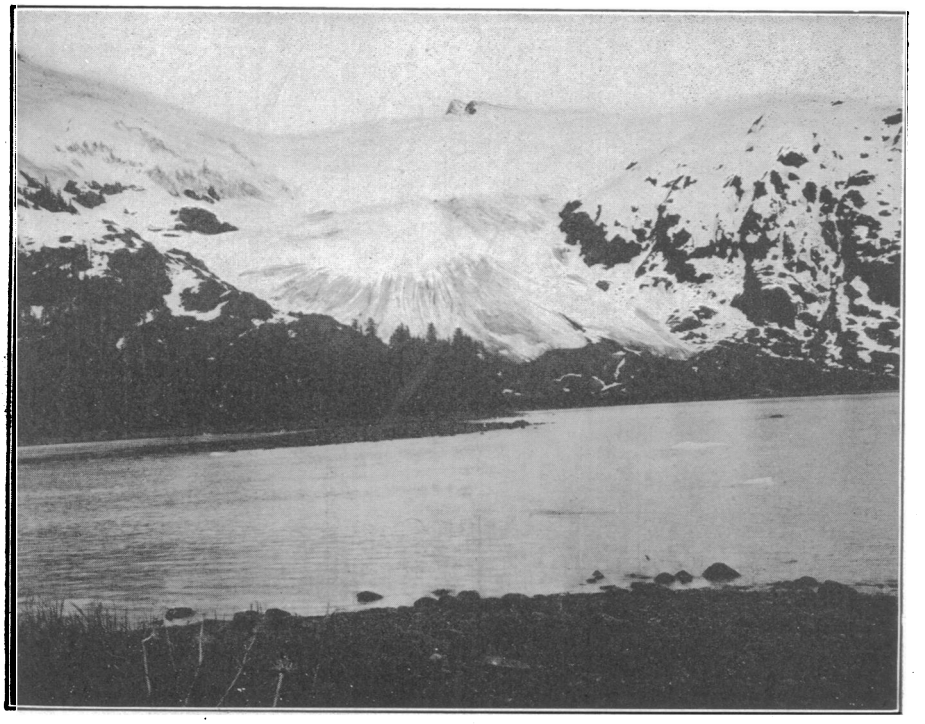

Fig. 2—One of the eastern ice lobes of the Blackstone Glacier from Point C of Fig. 1, July 5, 1909.

Canal and Turnagain Arm, for no large glacial stream enters the head of the Canal. A trail over this glacier was much used as a route from Prince William Sound to Cook Inlet till the Seward-Sunrise trail was opened. In 1898 Mendenhall visited the head of Passage Canal and crossed the portage to Cook Inlet. His description of this portage and the glacier† is of much interest, and the following paragraph is from his report:

* The *Bulletin*, vol. 43, 1911, p. 322, fig. 1.

† Mendenhall, W. C., A reconnaissance from Resurrection Bay to the Tanana River, Alaska, in 1898. *Twentieth Ann. Rep.* U. S. Geol. Survey, pt. 7, 1900, pp. 273, 325-326.

"The isthmus which connects Kenai Peninsula with the mainland is only about 12 or 13 miles broad from tide water to tide water, and probably stands but little above sea-level; but for 5 miles of this distance it is buried under a glacier which flows from the high mountains of the peninsula to the south. This glacier at its highest point is about 1,000 feet above tide, and can be crossed in a few hours from the open waters of Portage Bay by prospectors or others who desire to reach Sunrise City or the headwaters of Cook Inlet before this body of water is open to navigation in the spring. For more than a hundred years it has been used as a route, first, by the Russian and Indian traders, and later by miners, who usually cross it without difficulty in the winter or early spring. In the summer the crevasses open, and it is but rarely used, especially since at that

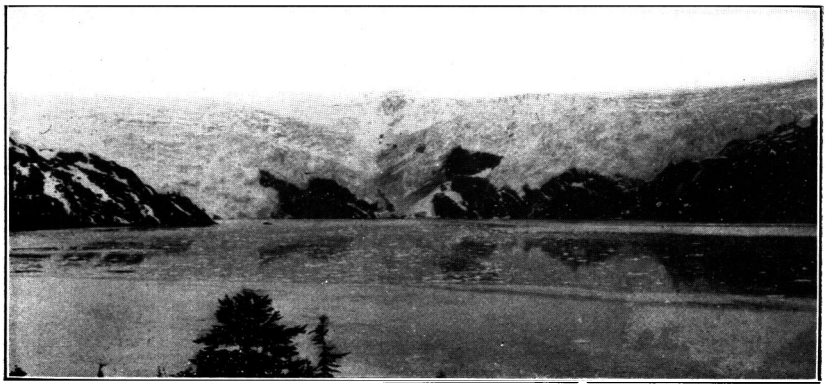

FIG. 3—Western tide-water part of front of Blackstone Glacier from Point D of Fig. 1, July 5, 1909.

season the all-water route is so much easier and cheaper. On the morning of our first trip across the portage a light rain was falling at the foot of the glacier, but before we reached its highest point we found ourselves enveloped in a blinding blizzard, which obliterated the well-beaten trail and hid completely from our view all landmarks which might serve to guide us. Fortunately the storm was at our backs, and helped rather than retarded our progress but even then, had it not been for bushes which earlier travelers over the same route had stuck in the snow to mark the trail under just such conditions, we should have been hopelessly lost."

BLACKSTONE BAY

The early maps of the shore line between Point Culross and Passage Canal were inaccurate, probably due to the fact that none

of the explorers making these maps followed closely the intricacies of the shore line. Blackstone Bay was fairly well shown except for its head, but Cochrane Bay was poorly delineated, and Culross Passage was not shown at all. Vancouver's map (1794) of this district and Tebenkof's (1849) have formed the basis for other and later maps. Applegate's map of 1887 adds some detail, and is the first map we have access to which indicates the Tebenkof Glacier. The passage (Culross) behind Point Culross was reported by the U. S. Geological Survey reconnaissance of 1905 and indicated on Chart No. 8502 of the U. S. Coast and Geodetic Survey in 1907.

On the maps of Vancouver and Tebenkof "ice and snow," which undoubtedly refers to a glacier discharging into the sea, are shown

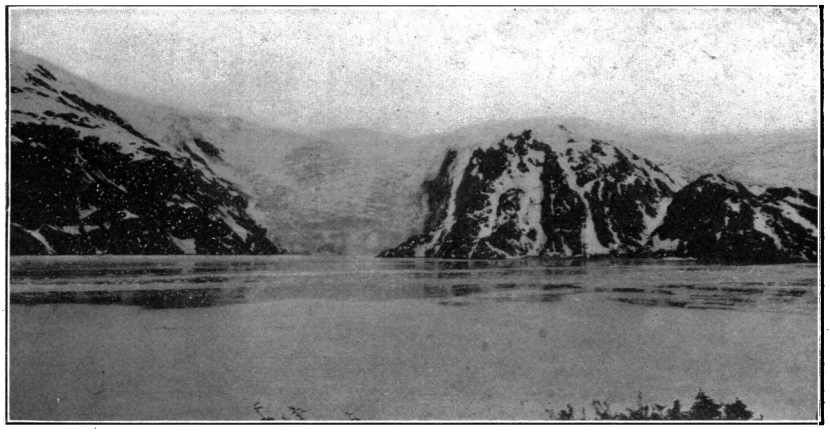

FIG. 4—Central tide-water part of Blackstone Glacier from Point D of Fig. 1, July 5, 1909.

at the head of Cochrane Bay and the description* indicates the same fact. There is evidently a mistake in locating this glacier,—it should be at the head of the next bay to the west (Blackstone Bay),—for there is no evidence that in historic time a glacier occupied the head of Cochrane Bay. The land at the head of this bay is comparatively low, and this low land extends south-southwest to Port Nellie Juan. The glacier seen by Vancouver was evidently the Blackstone Glacier which reaches the tide water at the head of Blackstone Bay.

Our information concerning the glaciers of Blackstone Bay was gained by a hurried reconnaissance on July 5, 1909. No information concerning the definite positions of the fronts of these glaciers at an earlier date is extant.

* Davidson, George. The glaciers of Alaska that are shown on Russian charts or mentioned in older narratives. *Trans. and Proc.* Geog. Soc. of the Pacific, series 2, vol. 3, 1904, p. 23.

Tebenkof Glacier

The front of the Tebenkof Glacier comes within about a mile and a quarter of the shore of a small bay on the south side of the entrance to Blackstone Bay, and is named after Capt. M. D. Tebenkof, Governor of Russian America from 1845 to 1850. This

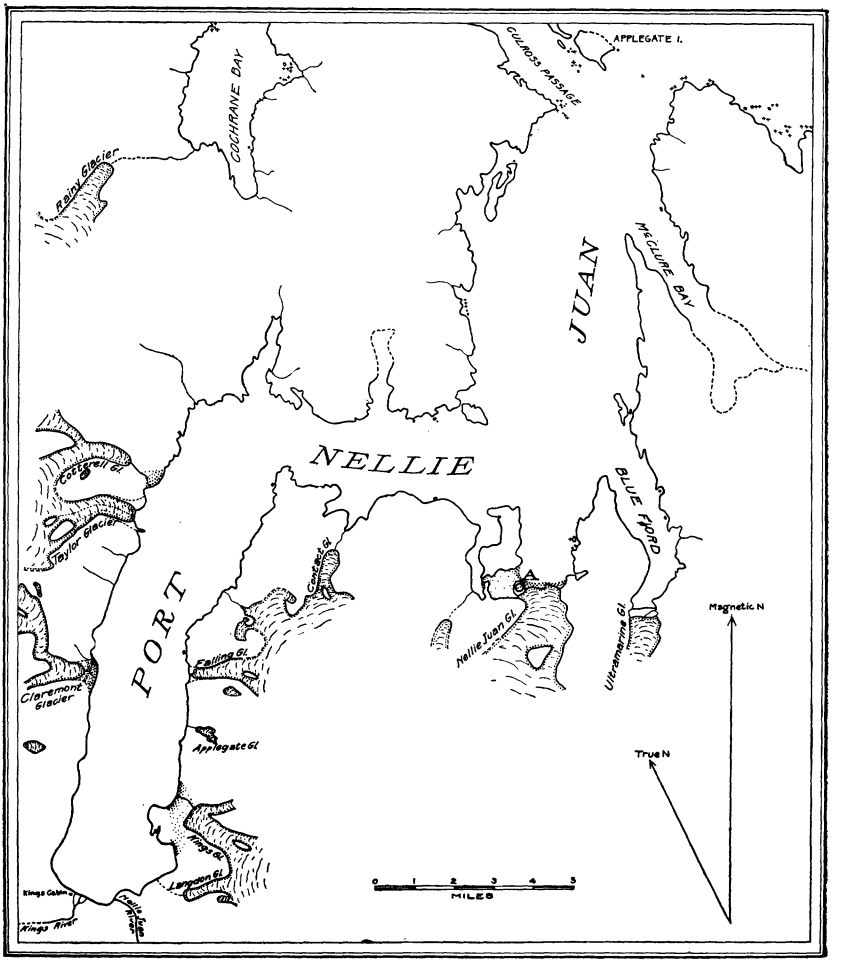

FIG. 5—Map of Port Nellie Juan, August 8 and 9, 1908.

glacier is an ice stream of from a mile and a half to two miles in width which flows northward in a valley parallel to Blackstone Bay. The ice field of this glacier is continuous with that of the Blackstone Glacier (Fig. 1). The Tebenkof Glacier has a comparatively low slope and its front lies on a flat of glacial débris. This flat has in

places a forest which would indicate that the glacier had not reached tide water in the last century, and probably not in a considerably longer period. On both sides of the front of the glacier there is a bare zone, estimated at 500 feet in width, which has apparently recently been covered by ice. The date of this advance, which probably destroyed part of the forest at the west edge of the glacier, is uncertain, but from the lack of vegetation on the bare zone it is thought that this advance took place within the last 10 or 15 years. The front of the glacier was not visited, and so nothing is known of the actual distance between the present front of the glacier and this recent advanced position, which marks the point of maximum advance since the growth of the present forest.

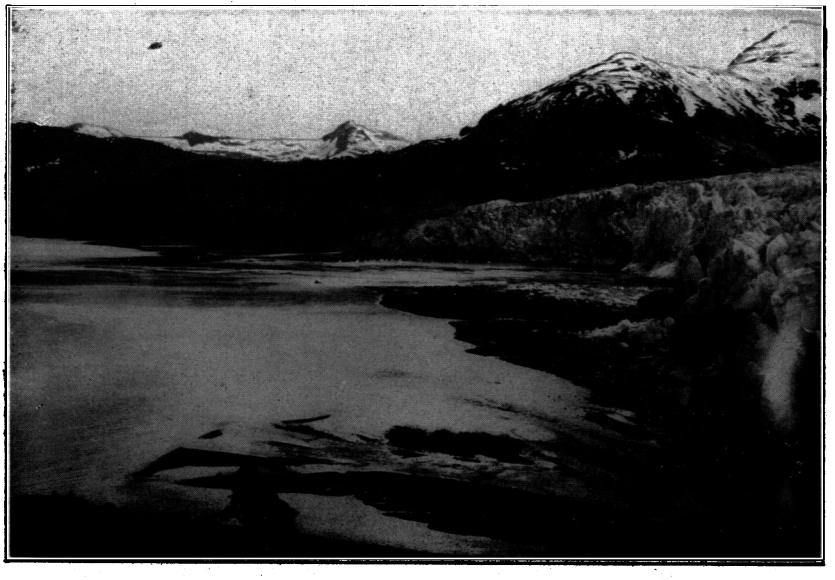

FIG. 6—Front of Nellie Juan Glacier from Point A of Fig. 5, August 8, 1908.

BLACKSTONE GLACIER

The Blackstone glacier surrounds the head of Blackstone Bay, sending down from a very extensive ice field no less than ten ice streams (Fig. 1). Two of these streams have discharging cliffs at sea-level and two others on the east side of the bay reach just to high tide on gravel aprons formed at the lower ends of the alpine valleys occupied by the glaciers. The earlier maps show the south end of Willard Island covered by ice, but as this seeming condition is very deceptive till one comes almost to the south end of the island,

and as the size and density of the vegetation on the island indicate a number of decades' growth, it is altogether probable that the ice has not been as far forward (north) as Willard Island within the time of which we have record, *i. e.* since 1794.

There is very good evidence, however, that at an earlier date, perhaps two centuries ago, the front of the Blackstone Glacier did extend well up to the north end of Willard Island. In figure 1 is shown the approximate position of this ancient ice front. North of the line indicated the island is heavily forested, but south of it by an abrupt change there are but sparse fir trees, though a dense growth of shrubbery has sprung up. On the west side of the island a small

FIG. 7—Bare zone recently occupied by ice, small moraine, and forest (at the right) untouched by the last recorded advance of the Nellie Juan Glacier, August 8, 1908. The small summit to the right of the center of the photograph is Point A of Fig. 5.

gravel point marks the old terminal moraine. No precise location of the old front could be determined on the west side of the bay. On the east side of both island and bay is a very notable accumulation of morainal material extending out from the island and the mainland, joining under a shallow channel where tidal currents run very swiftly. The two points south of Point C in figure 1 may be modified remains of two recessional moraines. Although the island itself is very sparsely timbered south of the old ice front the gravel deposits on the east side of the bay are heavily timbered (Fig. 2). The development of sparse and dense forests in approximately the same

time is doubtless due to the more favorable conditions for forestation upon the gravel than on the bare glaciated rock of the island.

The photographs here reproduced as figures 3 and 4 were taken from the south end of Willard Island. They show the two discharging portions of the glacier. The scenery from this point is nearly as wild and desolate as that at the head of Harriman Fiord. From the west through the south to the east one views a vast ice field almost barren of nunataks stretching back to a brilliant white skyline. From the central mass deploys tongue after tongue of ice which either laps down over smooth rock slopes or breaks into the sea. It requires but little effort of the imagination to picture all these streams

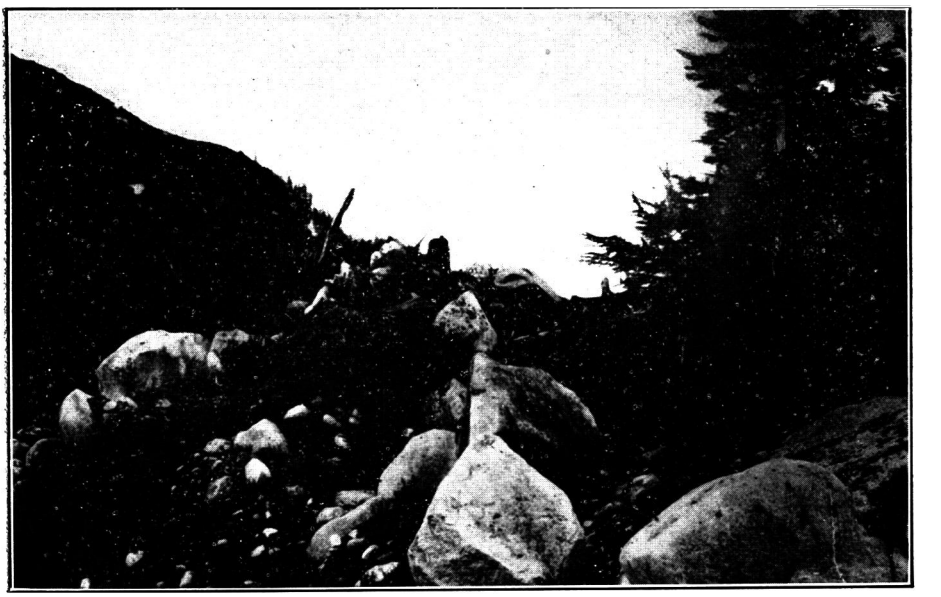

FIG. 8—Detail of the small moraine shown in Fig. 7, August 8, 1908. Fragments of trees overwhelmed by the ice may be seen in the moraine. The trees at the right were not injured by the ice which built the moraine.

coalesced into one giant ice-stream filling the whole head of the bay and extending far down over Willard Island to the ancient moraine.

PORT NELLIE JUAN

Port Nellie Juan (Fig. 5), sometimes called Kings Bay after a prospector who had a cabin near its head, is the most extensive embayment on the west coast of Prince William Sound. We visited this port on August 8 and 9, 1908, but did not examine in detail the glaciers on its west side.

South of the central part, and east of the southern part of Port

Nellie Juan is a snowfield of unknown but considerable extent. Several glaciers flow north and west from this field, and two of them, the Nellie Juan and the Falling glaciers, reach tide water. On the west side of the southern part of the port are other glaciers, one of

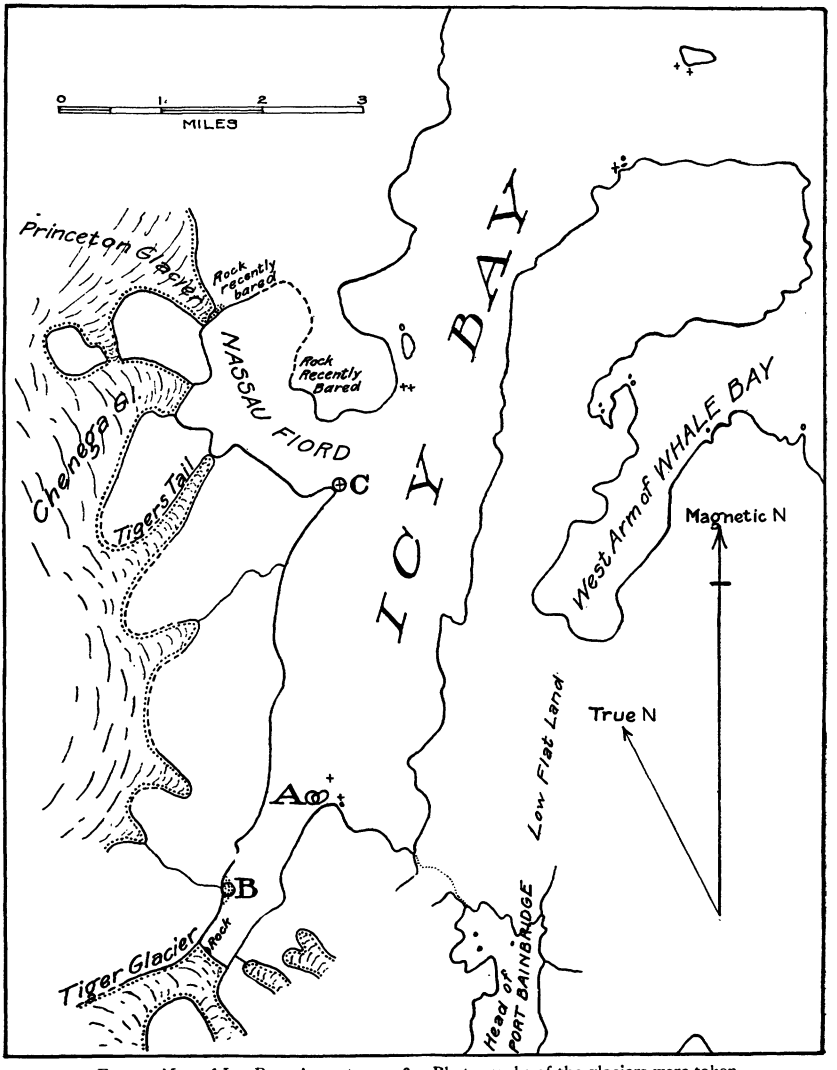

FIG. 9—Map of Icy Bay, August 5, 1908. Photographs of the glaciers were taken from Points A, B, and C.

which, the Taylor, reaches sea-level. The head of Port Nellie Juan is shallow and the waters very muddy. This is due to streams from the adjoining glaciers, and especially to the fact that the two large

streams, Kings and Nellie Juan rivers, entering the head of the port, are charged with glacial silt. These streams come from one of the largest ice covered areas of the Kenai Peninsula.

Ultramarine Glacier

The Ultramarine Glacier, so named because of the clear blue color of the ice near its end, is situated at the head of Blue Fiord, the second (from the entrance) deep indentation in the southeastern coast of Port Nellie Juan. The glacier comes within about a quarter of a mile of tide water and the western part of the front extends farther forward than the eastern two-thirds and rests on a glacial

Fig. 10—Chenega and Princeton (on the right) Glaciers from Point C of Fig. 9, August 5, 1908.

flat. The eastern part of the front rests on a rock ridge about 300 feet above the sea. On this ridge there is a marked bare zone, and also one on the side of the glacier. The front of the glacier was not visited, but at a distance this bare zone appeared as if the ice had retreated from it in the last two or three years. Applegate's map indicates that the glacier in 1887 reached to tide water along its whole front. The forest in front of the eastern part of the glacier shows that this could not have been the case, although the western part may have reached tide water at that time, but even this is doubtful. Our observations on this glacier were made at a distance of about a mile and a half.

Nellie Juan Glacier

The Nellie Juan Glacier (Figs 5 and 6) is the largest, at least in breadth of front, on Port Nellie Juan and is named after this port. The front of the glacier is distinctly in view from the entrance to the port, and rests on a gravel beach, most of which is covered by high tide; and near the center of the front the ice is bathed by low tide water. On both sides of the lower part of the glacier is a distinct bare zone of smoothed granite, and this bare zone, which is 100 to 500 feet in width, ends abruptly at the edge of a forest covered tract. This zone is prominently developed on a granite knob, almost

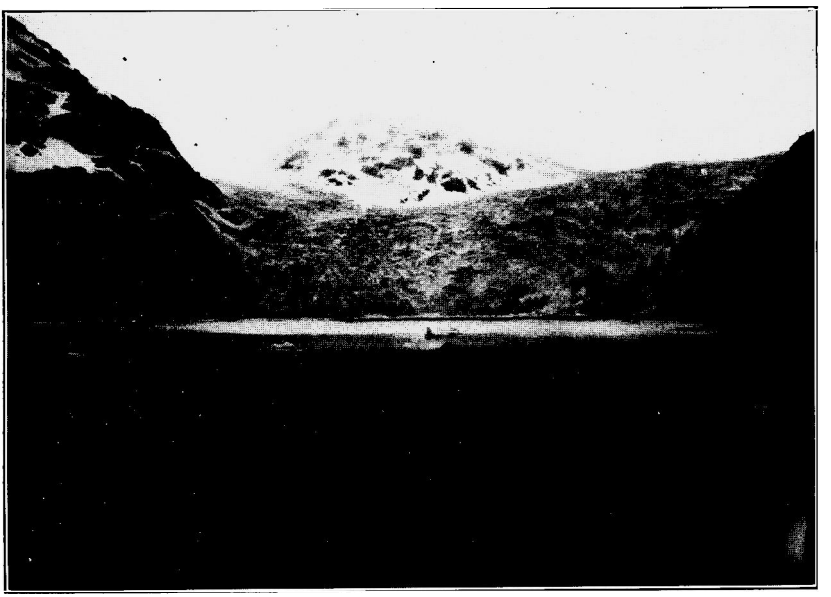

Fig. 11—Tiger Glacier from Point B of Fig. 9, August 5, 1908.

an island, at the west side of the glacial front. Crossing the top of this knob is a small moraine (at Point A on Fig. 5) from 1 to 10 feet in height and 5 to 30 feet in width. This moraine contains decaying fragments of trees, and just to the north of it is an area of scattering trees, some of which are a foot in diameter (see Figs. 7 and 8). To the south of the moraine is some vegetation,—moss, grass, alders 5 feet high, and a few spruce trees 4 feet high. Most of the vegetation disappears half way from the moraine to the ice front. From the extreme summit (Point A, Fig. 5) of the above granite knob the nearest point of the moraine is 48 feet distant in a direction

S. 10° W. From the same summit the extreme front of the glacier is 500 feet distant in a direction S. 13° W.

The moraine noted above marks the farthest advance of the ice since the growth of the present forest, *i. e.*, for a century, and most

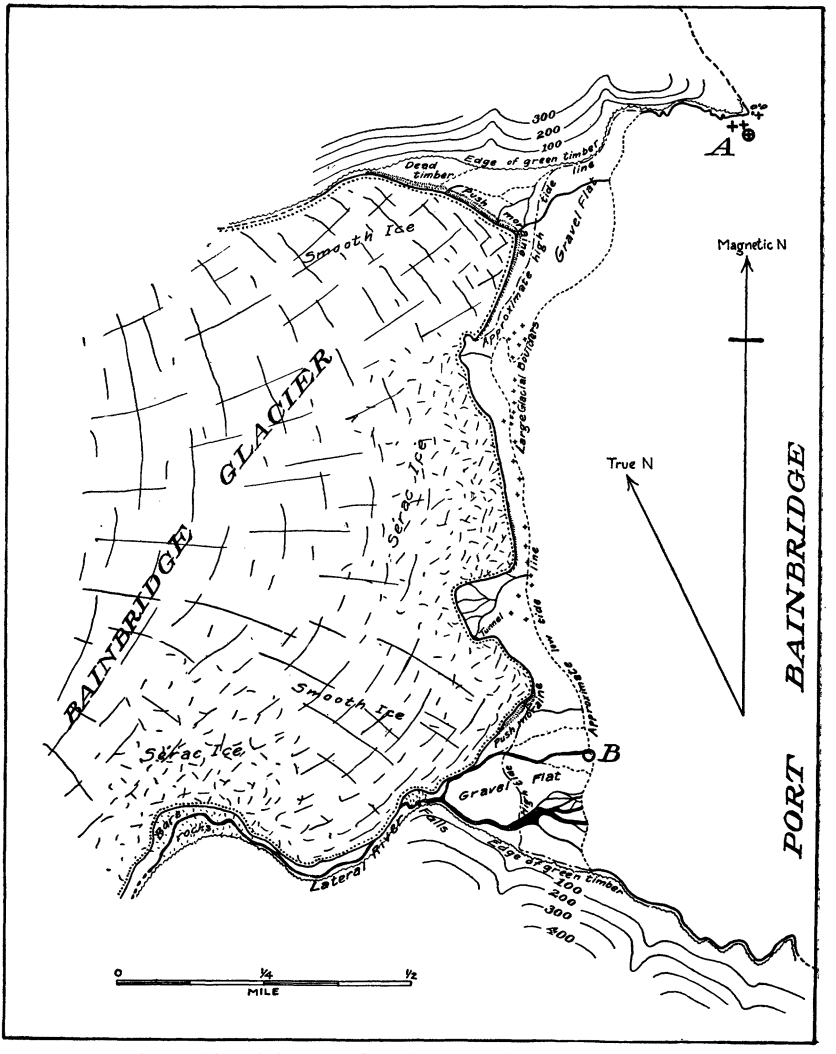

FIG. 12—Map of the front of the Bainbridge Glacier, August 3, 1908.

probably for a few centuries. The date of this maximum historical advance is, at a minimum, twenty years, and probably the actual date is considerably longer ago than twenty years.

ICY BAY

No glaciers exist near tide water in Prince William Sound between Port Nellie Juan and Icy Bay (Fig. 9), which is a fiord in the southwestern part of Prince William Sound. Its axis runs northeast and southwest and the fiord is approximately 10 miles in length. This bay has been represented on the maps as about 4 miles in length with an east and west axis. It was not until after the United States Geological Survey reconnaissance of 1908 that the bay was delineated with approximate accuracy.* The reason for this lies in the fact that the later maps followed Vancouver's representation of this bay,

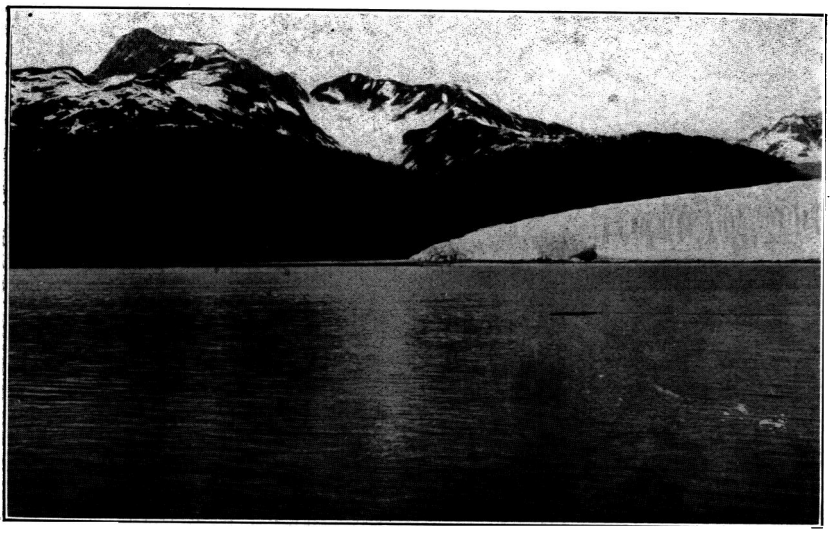

FIG. 13—Front of Bainbridge Glacier from Point A of Fig. 12, August 3, 1908. Point A is the top of the most southerly reef at the north side of the entrance to the shallow bay in which is the Bainbridge Glacier; this reef is covered by ordinary high tide.

and he reported† that the bay was "terminated by a compact body of ice that descended from high perpendicular cliffs to the water side." At that date (1794) it is very probable that the glaciers in Nassau Fiord, the large bay on the northwest side of Icy Bay, completely filled that fiord and extended out into, but not across, the main part of Icy Bay. This, together with the extensive discharge of ice from these glaciers (combined as one), probably prevented close inspection of the bay and the discovery of its upper part.

* Grant, U. S., and Higgins, D. F. Copper mining and prospecting on Prince William Sound. *Bull.* U. S. Geol. Survey No. 379, 1909, pl. 4.

† Quoted by Davidson, George, op. cit., pp. 23.

Our visit to Icy Bay was on Aug. 5, 1908, when we made a hasty reconnaissance of the bay, came within half a mile of the Tiger Glacier and obtained our information concerning the Chenega and Princeton glaciers from the rock islet (Point C on Fig. 9) at the entrance to Nassau Fiord. The following year Icy Bay was visited by the George W. Perkins' party, and the names here used are those proposed by that party with the exception of the name Chenega Gla-

FIG. 14—Extreme north side of front of Bainbridge Glacier showing moraine, overturned trees, and forest partly killed by outwash gravels. August 3, 1908.

cier and the use of the name Princeton for the glacier immediately northeast of the Chenega. The Chenega is the main discharging glacier in Icy Bay and has long been known locally by that name.

CHENEGA AND PRINCETON GLACIERS

The Chenega and Princeton glaciers reach tide water at the head of Nassau Fiord (Fig. 9). The former glacier is discharging

abundantly and furnishes most of the floating ice so common in, and about the mouth of Icy Bay. From the top of a small rock island at the entrance to Nassau Fiord (Point C of Fig. 9) a good view may be had of both the Chenega and Princeton glaciers (Fig. 10); the extreme southern edge of the front of the former is not visible from this point. The rock surface about the entrance to Nassau Fiord has been recently glaciated and no forest has developed on it. It is undoubtedly true that the entrance to this fiord, as well as the peninsula at the north side of the entrance, were covered by ice within the last 100 years, and quite possibly within a much shorter period. The Indians living at the settlement of Chenega have a tradition that the Chenega Glacier reached to the mouth of Icy Bay about 100

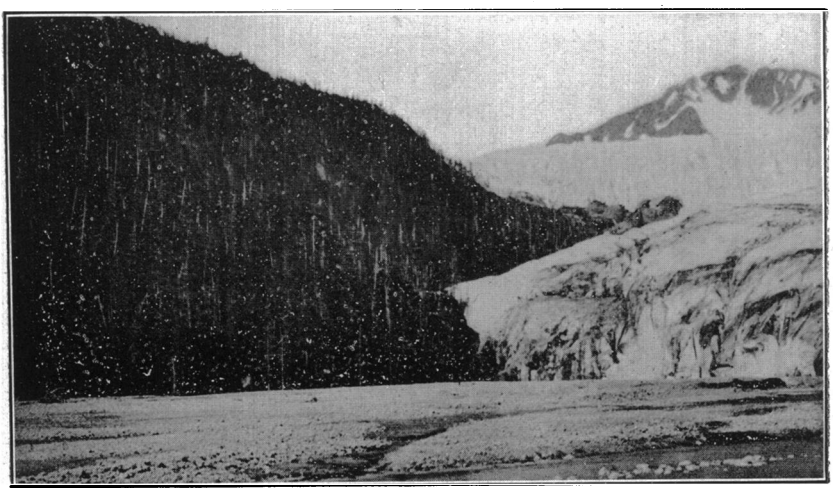

FIG. 15—Southern part of front of Bainbridge Glacier from Point B of Fig. 12, August 3, 1908.

years ago. But the growth of the forest about the bay and even well up past the mouth of Nassau Fiord precludes this idea. The tradition more reasonably would refer to the mouth of the northern arm (Nassau Fiord) rather than to Icy Bay itself.

TIGER GLACIER

The Tiger Glacier reaches tide water at the extreme head of Icy Bay. The front of the glacier is steep and its eastern side was discharging in 1908 with fair rapidity. The western half of the front shows a ledge of rock just emerging from under the ice (Fig. 11). Evidently an advance will cover up this ledge and a retreat will make it more prominent.

BAINBRIDGE GLACIER

The Bainbridge Glacier is the only tide water glacier on the port of that name. A mile north of this glacier is a smaller one ending about 500 feet above sea-level. The Bainbridge Glacier does not appear on the earlier maps, although it is in view from ships passing Point Elrington. The first map known to us which shows this glacier is a small one published in 1906.* The glacier had, however, been known long before that date and the name Bainbridge is in common use locally. We saw the glacier from a distance in 1905, and on August 3, 1908, visited it and mapped its front (Fig. 12).

The Bainbridge Glacier ends on a glacial flat, and the central part of the front is reached by the usual high tide, and thus an ice cliff is developed along this portion of the front. This cliff is approximately 100 feet in height and its top is composed of ragged ice pinnacles, singularly free from débris and showing in the sunlight a beautiful play of greenish blue colors. Near the northern part of the ice front is a push moraine, 10 feet high, in places directly at the edge of the ice and in other places as much as 60 feet from the ice. This moraine is very fresh, and probably was formed during the summer of 1908. The moraine includes fragments of trees, and towards the north encroaches upon a spruce forest, many of whose trees have been killed recently by being partially buried in glacial outwash (Fig. 14). On the south side of the front (Fig. 15) there is a small irregular bare zone of rock between the ice and the forest.

The photographs here reproduced (Figs. 13, 14 and 15) will mark the position of the front of the Bainbridge Glacier on August 3, 1908, and will be of service in determining future advance or retreat. In 1908 the ice was practically, if not absolutely, at its maximum advance since the growth of the present forest.

* Grant, U. S., Copper and other mineral resources of Prince William Sound. *Bull.* U. S. Geol. Survey No. 284, 1906, p. 79.